

VISION 2000

**A Plan To Reengineer HST Operations & Systems
Development**

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VISION 2000 is an initiative by the Hubble Space Telescope Operations and Ground Systems (O&GS) Project to streamline and modernize HST's overall operations and substantially reduce both operations and systems maintenance costs by the year 2000. It is to be accomplished through a coordinated, focused use of existing resources without impacting either the ongoing HST science-observing program or preparations for future Servicing Missions. The need for VISION 2000 is multifaceted. First, the management and operations philosophy, dates to the 1970s; the present systems have been continually patched and modified to accommodate changing interface and spacecraft needs. This means that operations are manually intensive and the aging hardware and software are increasingly more expensive to maintain. Second, system flexibility is lacking, which results in high cost to respond to new requirements or anomalies. On the other hand, new science instruments, to be installed in the 1997, 1999 and 2002 Servicing Missions, coupled with an increasing number of observers, are expected to increase further the load on the system. And finally, continued productive use of HST is expected to depend on substantially reducing the cost of operation in the years beyond 2000. Meeting these challenges, while improving the quality of HST observer support, is essential to ensure the long-term viability of HST as a world class facility for astronomy. To meet these challenges, VISION 2000 has adopted the following goals:

- **Achieve 100% observer satisfaction and increase the science user base.**
- **Be a technological leader in mission operations.**
- **Substantially reduce the cost of operating and maintaining HST.**

These goals are to be accomplished within the current 5-year budget plan. The payback afterward will position HST to service the astronomy community well beyond the year 2000.

The O&GS Project established feasibility of VISION 2000 through the work of three coordinated study task teams in early 1995. The teams: one for defining the operational concept, the second for devising a technically feasible system architecture, and the third, for establishing a workable implementation strategy and cost, had representation from the full spectrum of HST personnel including civil servants, contractors, observers, operators, developers, and managers. The results of all of these efforts were integrated at a Project retreat in February 1995, and are described in this brochure. **Based on these technical and programmatic results, and with full approval of GSFC top management and concurrence of NASA Headquarters, the O&GS Project is now moving confidently toward full implementation of VISION 2000.**

The Operations Concept for VISION 2000 reflects 5 years of HST mission operations experience which has enabled us to identify and eliminate in the future labor-intensive or inefficient processes, system and management bottlenecks, and functions which add little or no value. The new concept is based on the strategies of a) doing things right the first time at every stage within the overall process, b) using automation to perform routine, repetitive tasks, c) providing adequate tools and authority to the experts to perform their tasks directly, and d) streamlining the change process. Table 1 compares the attributes of the current operational approach with those of the VISION 2000 concept.

Table 1. Comparison of Operational Attributes

1995 Operations	2000 Operations
Manually intensive spacecraft telemetry monitoring	Automated real-time monitoring & anomaly detection
Manually intensive effort to configure systems	Automated ground system reconfiguration
Visual inspection of trending data to detect anomalies	System provides alert to actual & potential problems
Multiple iterations to generate valid mission timeline & TDRSS schedule	Single "pass-through," error-free mission timeline & command loads
Interface with & knowledge of multiple systems required to perform work	Tool kits provide direct access to user/operator
Decision-making authority complex	Localized decision making
Change process excessively long & complex	Minor changes made within days; major, within months
HST proposers require assistance to generate valid observing proposals	Proposers have HST-provided tools to generate valid, constraint-free proposals

The system architecture of VISION 2000 responds to the new operations concept by organizing all required mission processes into nonredundant, logical units . An end-to-end perspective - from the spacecraft to the science user - has been adopted to identify essential functions and their allocation, always keeping in mind the need to meet the twin goals of reducing operational and maintenance costs while enhancing user services.

The architecture, which begins and ends with the user - the scientific community - is organized into four building blocks or products as shown in Figure 1.

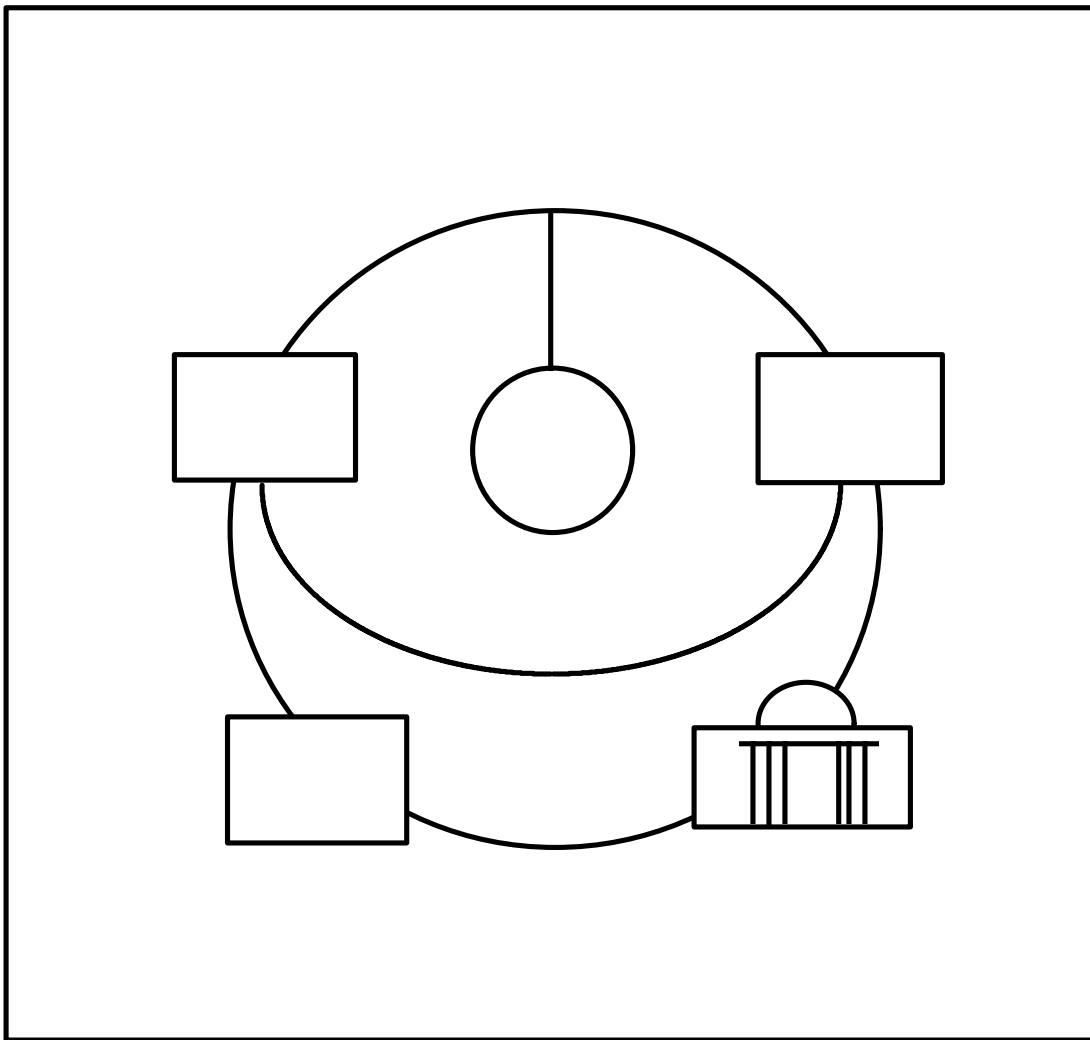


Figure 1. VISION 2000 System Architecture

The **Control Center System** provides secure, real-time monitoring and spacecraft commanding. Decision-based technology plays a key role in performing continuous monitoring and fault diagnostics of both flight and ground systems. HST subsystem trending is fully automated; platform-independent, desktop toolkits are provided in the special cases where further expert analysis is required. Tools are also provided to facilitate rapid update and management of all reference data used locally. Engineering telemetry and all science data are stored in an integrated archive easily accessed remotely or locally through a common, user-friendly interface. Authorized operators and analysts will be provided quick and easy access to all information they require without artificial constraints imposed by security requirements.

The **Planning and Scheduling System** begins with the provision of tools to the observer for generating a valid, constraint-free observing proposal. Immediate, interactive feedback allows quick resolution of conflicts. The processes of proposal interpretation, long-range planning and calendar building are fully integrated. And single-pass processing is used to develop command loads from the completed calendar, thereby significantly increasing system responsiveness for responding to exciting new science or quick recovery from anomalies while reducing rework and opportunities for errors. Process efficiency is further improved by incorporating spacecraft communications and engineering requirements in the planning and calendar build process, the same as science observational requirements.

The **Science Data Processing System** relies on a fully automated calibration and data archiving process flow. Engineering telemetry is processed to retrieve astrometry data in the science data processing pipeline. The operation of the Hubble Data Archive is automated and provides data access to scientific users, spacecraft engineers, and, as a new capability, the public by means of a standardized, user-friendly interface.

The **Co-Processor (COP) Migration** is a key aspect of VISION 2000, because it is a commitment to replace the aging HST main flight computer with a modern, easily programmable one, on the third Servicing Mission in November 1999. This enables migrating labor-intensive ground functions to the spacecraft, such as antenna pointing and gyro bias updating, which will increase operational efficiency and safety. The capabilities of the onboard Co-Processor will enable a graceful transition of these new capabilities between now and the Servicing Mission.

The Integrated Development Plan is the implementation blueprint for VISION 2000. This Plan, which will be maintained by a joint government-contractor Steering Group, focuses resources, allocated from the existing budget, and schedules in order to continue and improve support to the science community with the current system while, at the same time, either enhancing or replacing components to implement the VISION 2000 architecture. It allows systems development needed to support the 1997 Servicing Mission to proceed in parallel with the VISION 2000 development. Changes to the Plan, if not in response to a spacecraft anomaly, must be justified on a cost-benefit basis. Accommodation of major changes will mean re-prioritization of the implementation of VISION 2000 features. VISION 2000 is to be implemented through the use of Product Development Teams, one for each of the four architectural building blocks or systems. These Teams will utilize a modern approach to systems development wherein system users and developers work together in a flat, cross-functional arrangement to expedite implementation; users are involved in all stages from establishing detailed operational requirements through performing system acceptance testing. To a large degree, the Teams operate autonomously once their membership and implementation plan have been approved by the VISION 2000 Steering Group. HST contractors work alongside civil servants, from both the HST Operations Flight Projects and the Mission Operations & Data Systems Directorates, in a partnership arrangement where success will be measured in terms of meeting VISION 2000 goals and requirements.

Near Term Activities are concerned with organizing resources to facilitate VISION 2000 implementation and refining its operational concept.

Product Development Team formation and authorization is being completed. It is expected that in the early implementation phases, a significant fraction of our current work force will become involved, full-time, in VISION 2000 development work as members of different Teams. Membership on the Teams may change as the work proceeds. Others will be involved as "consultants" and provide specialized support for brief periods when needed. Everyone will be invited to make suggestions to the Teams regarding beneficial improvements and changes.

Management, through the Steering Group, is detailing the Integrated Development Plan. Reprioritization of some tasks will be required in order to meet the objectives of VISION 2000 within our current budget profile. Commitment to and enthusiasm for the Plan by

the highest corporate levels of all HST operations contractors, within both the Flight Projects Directorate and the Mission Operations & Data Systems Directorate, will be established.

Process analysis and improvement will be the key not only to release manpower needed to implement VISION 2000 but, more importantly, to achieve the most efficiency possible before the system design is finalized. As a result of this work, detailed operational concepts for each of the major process strings will be defined by mid-1995 through working meetings of system users and developers throughout the Project. These, in turn, become the "planning" requirements for the rapid-prototyping implementation approach which follows. In addition, working meetings are being held with mission operations groups at the Johnson Space Center and the Jet Propulsion Laboratory in order to benefit from their techniques and lessons learned for accomplishing operational streamlining.

Logistic preparations have begun in order to accommodate the new hardware. The current plan has a prototyping capability being implemented, separate from , but in close proximity to, the current control center located in Building 3/14 at GSFC. Technical information exchange among Team members and Teams, as well as status information for management oversight, will be facilitated by the introduction of a new Internet-based electronic information exchange system involving hypertext formats for relational topic search. Both public and controlled access versions will be available.

Further information is available via the World Wide Web.

The HST VISION 2000 Home page can be found at:

<http://vision.gsfc.nasa.gov>

